SVM_Examples

January 29, 2022

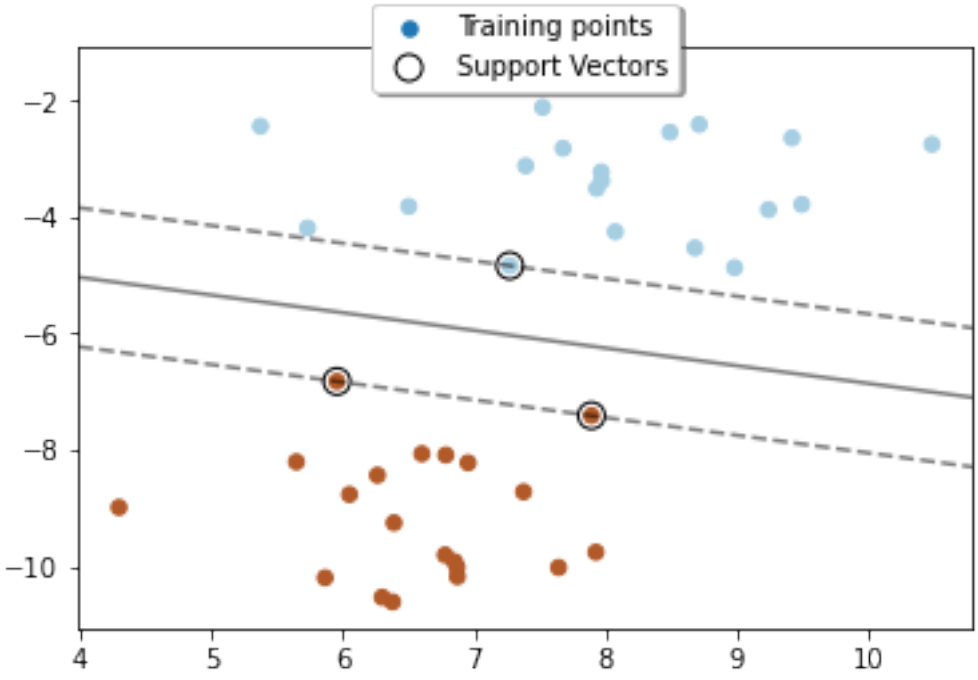
[1]:
```
%matplotlib inline
```

1 SVM: Maximum margin separating hyperplane

Plot the maximum margin separating hyperplane within a two-class separable dataset using a Support Vector Machine classifier with linear kernel.

[12]:
```
import numpy as np
import matplotlib.pyplot as plt
from sklearn import svm
from sklearn.datasets import make_blobs


# we create 40 separable points
X, y = make_blobs(n_samples=40, centers=2, random_state=6)

# fit the model, don't regularize for illustration purposes
clf = svm.SVC(kernel="linear", C=1000)
clf.fit(X, y)

plt.figure()

# plot the decision function
ax = plt.gca()
ax.scatter(X[:, 0], X[:, 1], c=y, s=30, cmap=plt.cm.Paired,label = 'Training␣
↪points')
xlim = ax.get_xlim()
ylim = ax.get_ylim()

# create grid to evaluate model
xx = np.linspace(xlim[0], xlim[1], 30)
yy = np.linspace(ylim[0], ylim[1], 30)
YY, XX = np.meshgrid(yy, xx)
xy = np.vstack([XX.ravel(), YY.ravel()]).T
Z = clf.decision_function(xy).reshape(XX.shape)

# plot decision boundary and margins
```

```
ax.contour(
    XX, YY, Z, colors="k", levels=[-1, 0, 1], alpha=0.5, linestyles=["--", "-","--"]
)
# plot support vectors
ax.scatter(
    clf.support_vectors_[:, 0],
    clf.support_vectors_[:, 1],
    s=100,
    linewidth=1,
    facecolors="none",
    edgecolors="k",
    label = 'Support Vectors'
)
ax.legend(
    loc="upper center",
    bbox_to_anchor=(0.5, 1.1),
    ncol=1,
    fancybox=True,
    shadow=True,
)

plt.show()
```



2 Support Vector Regression (SVR) using linear and non-linear kernels

Toy example of 1D regression using linear, polynomial and RBF kernels.

[3]:
```
import numpy as np
from sklearn.svm import SVR
import matplotlib.pyplot as plt

# ##############################################################################
# Generate sample data
X = np.sort(5 * np.random.rand(40, 1), axis=0)
y = np.sin(X).ravel()

# ##############################################################################
# Add noise to targets
y[::5] += 3 * (0.5 - np.random.rand(8))

# ##############################################################################
# Fit regression model
svr_rbf = SVR(kernel="rbf", C=100, gamma=0.1, epsilon=0.1)
svr_lin = SVR(kernel="linear", C=100, gamma="auto")
svr_poly = SVR(kernel="poly", C=100, gamma="auto", degree=3, epsilon=0.1,␣
 ↪coef0=1)

# ##############################################################################
# Look at the results
lw = 2

svrs = [svr_rbf, svr_lin, svr_poly]
kernel_label = ["RBF", "Linear", "Polynomial"]
model_color = ["m", "c", "g"]

fig, axes = plt.subplots(nrows=1, ncols=3, figsize=(15, 10), sharey=True)
for ix, svr in enumerate(svrs):
    axes[ix].plot(
        X,
        svr.fit(X, y).predict(X),
        color=model_color[ix],
        lw=lw,
        label="{} model".format(kernel_label[ix]),
    )
    axes[ix].scatter(
        X[svr.support_],
        y[svr.support_],
        facecolor="none",
        edgecolor=model_color[ix],
```

```
        s=50,
        label="{} support vectors".format(kernel_label[ix]),
    )
    axes[ix].scatter(
        X[np.setdiff1d(np.arange(len(X)), svr.support_)],
        y[np.setdiff1d(np.arange(len(X)), svr.support_)],
        facecolor="none",
        edgecolor="k",
        s=50,
        label="other training data",
    )
    axes[ix].legend(
        loc="upper center",
        bbox_to_anchor=(0.5, 1.1),
        ncol=1,
        fancybox=True,
        shadow=True,
    )

fig.text(0.5, 0.04, "data", ha="center", va="center")
fig.text(0.06, 0.5, "target", ha="center", va="center", rotation="vertical")
fig.suptitle("Support Vector Regression", fontsize=14)
plt.show()
```